

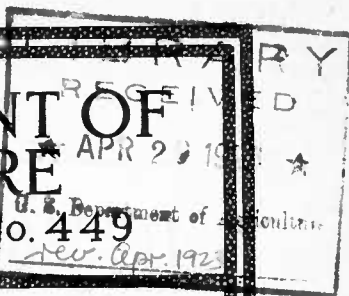
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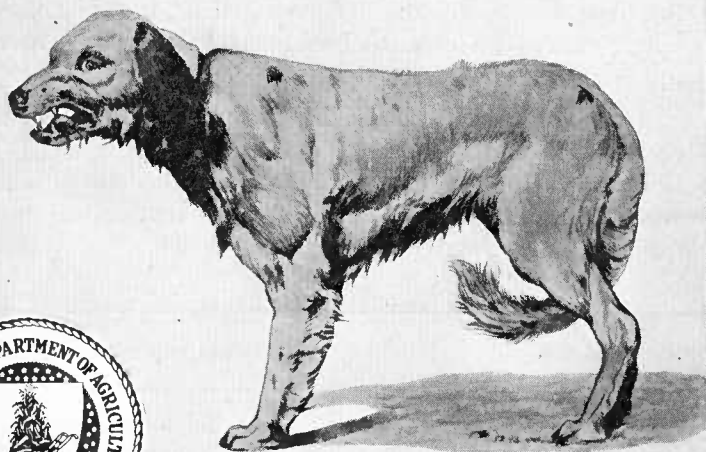
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# U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 449



## RABIES OR HYDROPHOBIA



**R**ABIES or hydrophobia is a specific, communicable disease affecting all warm-blooded animals, including man. The dog is especially susceptible, and because of his roving habits is the chief disseminator of the disease.

The bite of a rabid animal is not necessarily fatal; the virus is estimated to be transmitted in about 30 per cent of cases. But when the disease is contracted and not treated it is practically always fatal.

The Pasteur treatment prevents many fatalities, but even with this there is much anxiety, suffering, hardship, and expense.

Rabies can be transmitted only by animals that are actually diseased at the time. There is no foundation for the belief that persons bitten by a dog which subsequently becomes rabid may contract the malady.

This terrible disease is all too prevalent in the United States, in spite of the fact that its suppression is comparatively simple. The problem is solved when the rabid dog is eliminated. This is proved by the experience of some other countries, notably Norway, where the disease has been entirely stamped out.

A similar result might be brought about in this country, with the cooperation of the States, by (1) licensing all dogs, (2) muzzling all dogs not otherwise kept in restraint, and (3) rigid inspection and quarantine at borders and ports of entry.

# RABIES OR HYDROPHOBIA

By JOHN R. MOHLER, *Chief, Bureau of Animal Industry*

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## NATURE AND CHARACTERISTICS OF RABIES

**S**KEPTICISM with reference to the existence and prevalence of rabies in animals, or hydrophobia in man, strange as it may seem, is still entertained by a few prominent professional men. Their contention shows an unwillingness to accept the work of reputable investigators with regard to this particular disease, although other results obtained by the same investigators upon allied subjects are accepted and advocated. There is no greater galaxy of names associated with the study of any of the infectious diseases than is connected with the experimental investigation of rabies. The ablest scientists who have adorned the medical and veterinary professions, and to whom we owe the greatest deference for having advanced our knowledge of contagious diseases, have repeatedly shown by their experiments that rabies is a specific, communicable disease, preeminently affecting the canine race, although all warm-blooded animals, including man, are susceptible to it.

Many years of patient scientific research have been required to lead these investigators to a clear comprehension of the nature and characteristics of this disease. It was known and described several centuries prior to the beginning of the Christian era, and from the dawn of history the disease has been feared and dreaded. But it has been only in comparatively recent years that we have arrived at a tolerably clear understanding of the facts concerning this disease, which have to a certain degree displaced many of the fallacies and superstitions that have had a strong hold upon the public mind for many years. Indeed, it is still a widely prevalent belief that if persons or animals are bitten by a dog they are liable to become rabid if the dog should contract the disease at any future time. There is no foundation for this impression, and it would be a great comfort to many people who are now and then bitten by animals if the fallacy of this idea were appreciated. All experience, both scientific and practical, goes to show that rabies is transmitted only by animals that are actually diseased at the time the bite is inflicted. Under natural conditions this is the sole method by which the disease is transmitted, and therefore the old idea of spontaneous generation of the malady is absolutely fallacious. Artificially, it may be readily produced by inoculating susceptible animals with an emulsion of the brain or spinal cord or

with the saliva, milk, and other secretions of the affected animal. The blood, on the other hand, seems to be free from the infectious principle. The saliva contains the virus which under natural conditions is introduced into or under the skin on the tooth of the rabid animal.

Following the canine race, cattle seem to be the most frequently affected, probably because rabid dogs, next to their morbid desire to attack members of their own race, have a better opportunity to bite grazing cattle than any other species of animals. The relative frequency of rabies in these two species of animals is indicated by the carefully compiled statistics of Germany, which show that 371 dogs and 30 cows died of rabies in 1911.

Every animal or person bitten does not necessarily develop the disease and the percentage of fatalities has been variously estimated. According to Hogyes the proportion of persons who contract the disease after being bitten by rabid dogs and not treated is conservatively estimated at 15 per cent. The percentage is considerably higher in man following bites by the wolf. From 35 to 45 per cent of the dogs, 40 per cent of the horses, 36 per cent of the hogs, and from 25 to 30 per cent of the cattle bitten by rabid animals contract the disease, making a general average of about 30 per cent. This, however, depends on the location and size of the wound, as well as the amount of hemorrhage produced, and various other conditions. In general, the nearer the bite is located to the central nervous system and the deeper the wound is inflicted, the greater is the danger of a fatal result. In cases where the hemorrhage resulting from the bite is profuse, there is a possibility that the virus will be washed out of the wound and thus obviate the danger of subsequent appearance of the disease.

The virus after being deposited in the wound remains latent for an extremely variable period of time, which also depends on the size and depth of the wound as well as its location and the amount of virulent saliva introduced. Experiments have proved that the virus follows the course of the nerves to the spinal cord and along the latter to the brain before the symptoms appear. Gerlach, having collected statistics from a large number of cases, has found the period between the bite and the appearance of the first symptom to vary from 14 to 285 days. The great majority of cases, however, contract the disease in from three weeks to three months after the bite has been inflicted. It has been clearly demonstrated by the experiments of Roux and Nocard that the bite of a dog is infectious at least three days before it manifests symptoms of rabies, while at the Athens (Greece) Pasteur Institute infection was noted in the saliva eight days before the dog showed signs of the disease.

#### CAUSE OF THE DISEASE

Rabies is a specific infectious disease involving the nervous system and characterized by extreme excitability and other disorders, practically always terminating in death. The contagion of this disease has never been isolated, but the fact that the disease is caused by a specific organism principally found in the nervous system is indisputable. For instance, if an emulsion of the brain of a rabid animal is rapidly filtered through a fine Pasteur-Chamberland filter, the filtrate will be harmless. On the other hand, if a similar emulsion is filtered through the more porous Berkefeld filter, the virus will be found in the filtrate. This fact indicates that the infectious principle

is not in solution, but is an organism of such size as to be withheld from the filtrate by a very fine filter. Further proof of the organic nature of the virus is furnished by the fact that heating at 50° C. for one hour will render the virulent emulsion inert, while similar results follow its exposure to light for 14 hours, to the usual antiseptic solutions for a short period, or to the action of the gastric juice.

This contagion can be propagated only in the body of an animal, and despite numerous attempts to cultivate it artificially upon various culture media only negative results have followed.

There is no doubt that between rabies and other well-known infectious diseases there are analogies at many points, the most striking being the protective immunization which constitutes the great work of Pasteur. Moreover, the disease is transmitted from one animal to another through a long series, which indicates the presence of living organism capable of multiplication, rather than a mere toxin which would naturally become greatly diluted and harmless by passage through such a series. In addition, the behavior of the disease makes us certain that it is caused by a specific microorganism which, after introduction into the body, undergoes a period of incubation, during which it multiplies and subsequently produces certain definite symptoms and lesions which terminate in death.

Innumerable attempts have been made to discover the causative agent, and investigators have announced the finding of many of the lower forms of animal and vegetable life as the pathogenic factor. Certain protozoanlike bodies, found in 1903 by Negri in the ganglionic cells, and termed "Negri bodies," are of a very suggestive nature. Negri claims that these bodies are not only specific for rabies but that they are protozoa and the cause of the disease. His work has been corroborated by investigators in all parts of the scientific world. An examination of the vitality of Negri bodies will show a striking resemblance to the vitality of an emulsion of the virulent tissue. Thus, Negri bodies have been found to be quite resistant to external agencies, such as putrefaction, drying, etc., and are about the last portion of the nerve cell to survive the advance of decomposition. They are also found in over 96 per cent of the cases of rabies examined, but have not been proved to exist in other diseases. As a result of the work performed in the New York City board of health laboratory, Park claims that Negri bodies are found in animals before the beginning of visible symptoms, and evidence is given that they may be found early enough to account for the infectiousness of the central nervous system.

These bodies are now almost universally considered as diagnostic of rabies, and in the pathological laboratory of the Bureau of Animal Industry their detection in the nerve cells of the brain suffices for a diagnosis of rabies without animal inoculations. In case these granular bodies are not found in a suspected animal, the inoculation of rabbits is then made as a last resort. It is indeed rare that positive results are obtained from the latter method after the first method has been negative, but it has occurred occasionally in cases where the animal had been killed in the early stages of the disease.

#### SYMPTOMS

The symptoms of rabies are quite characteristic, and may be divided into two types—(1) the furious, violent, or irritable, and

(2) the dumb or paralytic. They vary somewhat in each species, but as the disease in the dog is the most important, it will receive principal attention at this time.

#### FURIOUS RABIES IN THE DOG

Following the period of incubation of the disease, which is usually between three weeks and three months, there is first noticed in the furious form of rabies a marked change in the disposition of the animal, which should at once arouse suspicion. An affectionate dog may become morose and depressed, while a snapping, treacherous animal may become cowardly or affectionate. This is known as the stage of development, and in one or two days is followed by an irresistible tendency to roam. If prevented the dog will fight or bite at the restraint or at anything that interferes with his freedom. This roving may occur for one to three days, during which he travels aimlessly in a nervous and irritable condition. His instinctive methods of defense are nearly always highly developed or exaggerated, but he seldom willfully attacks persons or other animals without provocation. When he returns, if not destroyed in the meanwhile, he shows from his exhausted, dirty, sheepish, or depressed appearance evidences of wandering. Having returned home, he frequently seeks secluded places such as are found under the house or porch.

During this period of roving he exhibits a disposition to eat or chew indigestible objects, as rags, leather, straw, feathers, sticks, and even pieces of coal, which are often swallowed. The secretion of saliva in some cases appears to be excessive, owing to the inability to swallow, and it sometimes becomes frothy from the champing of the jaws. However, foaming at the mouth is not a constant symptom of rabies, as is commonly believed by the layman; and furthermore, it is frequently misleading owing to the fact that it may be observed in other diseases. The erroneous opinion among the laity that dogs suffering with this disease are afraid of water is also misleading, since such dogs have been known to swim streams in their roamings. On the other hand, they appear to be afraid of nothing, as is evidenced by attacking all animals regardless of size.

A change in the voice of the animal is peculiar to this affection, and is due to the beginning paralysis of the throat, which usually sets in early. Instead of the normal bark the affected dog makes a long, resonant, peculiarly drawn-out bark which has been likened to the yelp of a coyote. Later, as the paralysis gradually extends, barking and swallowing become impossible, although attempts may be made to swallow. At this stage the muscles of the jaw become paralyzed, causing the lower jaw to drop and the tongue to hang out, which makes it collect dirt and appear dry and darker in color. Owing to this latter symptom the disease has been erroneously termed "black tongue" in certain sections. Upon closer observation the pupil of the eye is frequently found to be dilated. The paralysis continues to extend, the hind legs become involved, and the dumb form of the disease results. Finally death follows in from four to eight days after the development of the first symptoms.

#### DUMB RABIES IN THE DOG

The dumb or paralytic form of rabies is much more infrequent than the furious type, and is characterized by the early appearance

of paralysis without symptoms of frenzy or irritability which are observed in the early stages of the furious form. Therefore the animal affected with this type of the disease is not capable of doing much damage. Indeed the dog is much depressed from the beginning and seeks quiet spots or hides in some secluded place. Probably the first symptom noted by the owner is the paralysis of the lower jaw, as a result of which the animal is often suspected of having a "bone in its throat." The paralysis quickly progresses until it involves the legs and trunk and results in death in from one to three days.

#### RABIES IN CATTLE

In cattle both furious and dumb rabies are met with as in dogs, the former being the more common. However, a sharp line of distinction can not always be drawn between these two forms of the disease, as the furious type usually merges into the dumb, due to the paralysis which always appears prior to death. The typical cases of dumb rabies are those where the paralysis occurs at the beginning of the attack and remains until the death of the animal. The disease first manifests itself by loss of appetite, stopping of the secretion of milk, great restlessness, anxiety, manifestation of fear, and change in the disposition of the animal. This preliminary stage is followed in a day or two by the stage of excitation or madness, which is indicated by increasing restlessness, loud bellowing with a peculiar change in the sound of the voice, violent butting with the horns and pawing the ground with the feet, with an insane tendency to attack other animals, although the desire to bite is not so marked in cattle as in the canine race. About the fourth day the animal usually becomes quieter and the walk is stiff, unsteady, and swaying, showing that the final paralysis is coming on. Loss of flesh is extremely rapid, and even during the short course of the disease the animal becomes exceedingly emaciated. The temperature is never elevated, but usually remains about normal or even subnormal. Finally there is complete paralysis of the hind quarters, the animal being unable to rise, and, but for irregular convulsive movements, lies in a comatose condition and dies usually in from four to six days after the appearance of the first symptoms.

#### RABIES IN CATS

When the disease attacks cats, these animals generally hide themselves under the furniture or in some dark hidden corner, and there they may die unobserved in the course of a day or two. As a rule, however, the disease implies danger for human beings. The rabid cat becomes very bellicose; from the dark corner where it has hidden itself it will suddenly attack animals or persons, and especially when children are involved it will jump up to the face and inflict severe wounds with its teeth and claws. In the violence of this attack it frequently bites itself. The rabid cat loses its voice, being able only to mew hoarsely. Later it loses its appetite, has difficulty in swallowing, becomes emaciated, and succumbs within several days with symptoms of paralysis.

#### RABIES IN OTHER ANIMALS

Horses, sheep, goats, hogs, chickens, and animals of prey such as wolves, foxes, badgers, and martens also contract rabies when bitten



by rabid animals, and behave quite similarly to rabid dogs, cattle, and cats.

#### POST-MORTEM APPEARANCES

In rabies there are no constant or definite lesions observed on post-mortem examination of the carcass. In fact, the alterations are slight, variable, and almost absent at times, so that unless there is a good history or characteristic symptoms a positive diagnosis can not be made without recourse to microscopic examination or animal inoculations of the brain of the suspected animal. The most suggestive indication of rabies is the presence in the stomach of unusual bodies such as stones, wood, earth, cloth, iron, feathers, etc. Frequently the stomach is empty of food but distended with material of this character. Its mucous membrane is frequently inflamed and at times a marked reddening of the folds of the stomach, with or without erosions, is noticed. There may also be an inflammation of the covering of the brain and cord as well as of the mucous lining of the mouth, throat, and respiratory tract. The feet of rabid dogs may present sores and bruises, denoting extensive travel which had been accomplished during the period of roving. The heart and pericardium are often inflamed, but these and similar lesions are more frequently due to the condition of the animal before dying than to any specific alteration. The carcass rapidly undergoes decomposition.

#### TRANSMISSION OF THE DISEASE BY MILK AND MEAT

While the virus of rabies is most frequently found in the central nervous system and the salivary glands, it may also be found in other glands and secretions, including the mammary glands and the milk. That rabies may at times be excreted with the milk has been proved by several experiments. In one of these experiments the milk of a rabid bitch having a litter of puppies was inoculated intramuscularly into rabbits and guinea pigs, and produced typical rabies; but the puppies, removed from the mother when the first symptoms developed, were kept under observation for 18 months without developing the disease. The reason for these negative results in the puppies may be explained (1) by not having been bitten by the mother before she was removed, and (2) the absence of any abrasion in the alimentary tract through which the virus could have entered the circulation.

It is a generally accepted fact that rabies can not be transmitted to normal animals through food containing the virus of the disease unless lesions are present in the alimentary canal; but the conclusion that there is no danger to the consumer from the meat or milk of animals that are rabid is not tenable, since abrasions of the lips, mouth, and pharynx are all too frequent to permit of such risks. These products must therefore be considered as dangerous to health.

One case is on record where a baby in Cuba developed rabies from nursing its mother while the latter was in the early stages of hydrophobia. In this case, however, the virus in the milk may have entered the circulation through abrasions of the gums during teething. Similar cases have been reported in veterinary practice where the virus of rabies was observed to have been passed to the offspring through the mother's milk, but in these cases it is impossible to eliminate an obscure bite from the bitch or lesions of the gums during this early age. While it is not probable that cattle would be

milked after the symptoms of rabies developed, it is nevertheless important to realize the danger of using such milk and the necessity for preventing calves from sucking such diseased cows.

All attempts to convey the disease to healthy dogs by feeding them upon meat from infected animals have given negative results.<sup>1</sup> Nevertheless the meat of rabid animals must be considered as unfit for food, and the meat-inspection regulations enforced by the various countries having such inspection provide for the total condemnation of the carcasses of these animals.

Infection has occurred in man from making autopsies on rabid dogs, and it is likewise possible to result if inoculation occurs while handling the meat of rabid cattle, hogs, or sheep. A veterinary student at Copenhagen infected a wound on his finger while making an autopsy on a dog dead of rabies and died of the disease. Another somewhat similar case occurred in a veterinary student at Dresden in consequence of an injury received while holding a post-mortem on a rabid dog.

In an attempt to discover the reason that no illness followed the eating of the meat and even the brain of rabid animals, a test was made of the action of the gastric juice upon infectious material in a test tube. Twenty-one rabbits were inoculated with this artificially digested virus, but not one animal contracted the disease, while all the 17 check rabbits which were inoculated with undigested rabies virus developed the disease and died. It is evident, therefore, that the gastric juice has a pronounced deleterious effect upon the virus of rabies.

#### DIFFERENTIAL DIAGNOSIS

The present advocates of the assumption that rabies is a disease of the imagination should be better fortified in both their facts and their theory. Little children certainly do not die after a dog bite from the effects on the imagination, nor do horses, cattle, sheep, hogs, dogs, rabbits, and monkeys die from an imaginary disease. It must be more than a mere coincidence that ever since the recognition of this disease in the days of Aristotle this peculiar mode of death has occurred only after infection by a rabid animal. The daily newspapers may add to the sensational details of these occurrences, but there is no doubt of the real danger involved.

Anyone who has seen the suffering of one human being affected with this fatal disease will readily concede that no amount of inconvenience caused animals by muzzling or other protective arrangement can ever be considered too much to prevent such suffering, nor should it prove difficult to differentiate between hydrophobia and the pseudo form, which has been termed lyssophobia, if all the cases of these diseases were as typical as the two which were brought to the writer's attention.

Through the courtesy of Dr. William C. Woodward, at that time health officer of the District of Columbia, I was invited to visit Freedmen's Hospital for the purpose of seeing a patient whose case had been diagnosed by the resident surgeon as suspected hydrophobia. The woman, 28 years of age, had been fiercely attacked and severely bitten on the right forearm and about the face by a stray collie dog. Eighteen days later she complained of a general malaise

<sup>1</sup> Claudio Fermi produced rabies in rats and mice by feeding them rabietic material with their food. About 60 per cent of the 70 animals so fed died of paralytic rabies.

and pains in the cicatrized wounds of the head, which rapidly grew more severe, necessitating the services of a physician, upon whose advice the patient was removed to the hospital on the following day. My visit occurred on the afternoon of the succeeding day, at which time the patient was found in an extremely nervous condition, having an excessive feeling of fear and uneasiness. The eyes were staring and a general expression of anxiety pervaded her countenance. Her mind was clear, and no efforts at violence were made. When interviewed as to the scars on her head and forearm she lightly replied, "Oh, a dog bit me there some weeks ago, but they are all right now."

From time to time reflex spasms involving the muscles of the throat were noticed, causing a clutching at the throat and difficult breathing during the attack. These rapidly became more generalized and soon involved the respiratory muscles, causing labored breathing. Attempts at vomiting would then occur, but no evacuations followed. Contrary to the views of our skeptical friends, the patient accredited these symptoms to indigestion, and had not the slightest suspicion of the true nature of her condition, thus disproving the idea that the nervousness and fear usually seen in the early stages of rabies in the human subject are due to the natural dread of the disease and apprehension of the consequences rather than to organic change in the central nervous system. During the night these symptoms became more aggravated and spasms followed one another more rapidly, causing grave delirium. The patient finally became violent, requiring the adoption of forcible measures to keep her under control. Death occurred on the following morning, 21 days after the bites had been inflicted. On post-mortem examination no lesions were found which could be held accountable for the symptoms which resulted in death, but microscopic examinations of the nerve ganglia and the brain, as well as the inoculation of rabbits with an emulsion of the brain, resulted in the confirmation of the diagnosis of hydrophobia.

That the appearance of a disease like rabies in a community seems peculiarly and in an extraordinary degree to be associated with an atmosphere of hysterical simulation and to inspire states of auto-suggestion must be admitted. One case of this character came to my attention through the kindness of a local physician which is in direct contrast to the instance cited above.

A young man, 24 years of age, employed as a clerk in a dry goods store, was bitten on a Saturday morning by a watchdog belonging to the proprietor. The bite, which was slight, had been immediately cauterized, and no further attention was given to the incident until Wednesday morning, when the young man fainted at the counter. Upon reviving he stated that he had been reading about rabies and the symptoms which would develop in man from the bite of a rabid dog, and insisted that he was developing hydrophobia as a result of having been bitten by the watchdog. He was immediately sent to his home and the dog brought to the bureau to be kept under observation. Two days later the young man was in a very hysterical state and kept insisting that the dog that bit him was rabid. During this time the patient had been in bed and seemed to have had marked paroxysms. He would roll himself over and over in his bed, snarling, growling, and snapping at the bed clothes. He would catch the pillow or sheet with his teeth and shake it like a terrier shaking a rat,

and in numerous other ways would show more imitative accuracy than in the genuine disease. At first it was impossible to attract his attention, although he would mutter and talk to himself. When he was informed that the dog that bit him did not have rabies, that it was alive and well, and that even if it did develop rabies several weeks later it would have no bearing on his case, as the saliva would not be virulent such a long period before the development of the symptoms in the dog, and furthermore that he had developed symptoms entirely too soon after the bite had been inflicted, as a longer period of incubation had to intervene for the virus to multiply and produce its effects, he commenced to realize that he had been making himself a victim of autosuggestion, and rapid recovery followed.

Here was a typical case of lyssophobia or pseudorabies, a figment of an overworked imagination, and, as in all cases of this class, recovery took place instead of death, which is always the termination of the true disease.

It has been stated by certain physicians that tetanus (lockjaw) is undoubtedly the true cause of death in the majority of instances where rabies has been diagnosed. It is not my purpose to give a differential diagnosis between these two diseases in man, but there is such a marked difference between a horse or a cow or a dog that is affected with tetanus and one that is affected with rabies, that a few brief words on differential characteristics will be given.

Tetanus may be readily differentiated from rabies by the persistence of muscular cramps, especially of the neck and abdomen, which cause these muscles to become set and hard as wood. In tetanus there is also an absence of a depraved appetite or of a willful propensity to hurt other animals or damage the surroundings. The general muscular contraction gives the animal a rigid appearance, and there is an absence of paralysis which marks the advanced stage of rabies. The dumb form of rabies in dogs is characterized by a paralysis and pendency of the lower jaw, while in tetanus the jaws are locked. This locking of the jaws in horses is very characteristic, and in cattle or dogs it renders the animals incapable of bellowing or barking as in rabies. Finally, tetanus may be distinguished from rabies by the fact that the central nervous system does not contain the infectious principle, while in rabies the inoculation of test animals with the brain or cord of a rabid animal will produce the disease with characteristic symptoms after an interval of 15 to 20 days. This period of incubation is much longer than in tetanus, since the inoculation of rabbits with tetanus bacilli invariably results in death after a short period, usually within 3 or 4 days.

#### DISTRIBUTION AND PREVALENCE

There is no intention of assuming the part of an alarmist with reference to the increasing prevalence of rabies. It can not be denied, however, that there is at present unusual occasion for alarm in certain parts of this country. It may be true that many newspaper stories have been exaggerated or are entirely false, but it is not true that all are fabrications. This is shown by a number of cases traced by the writer where the diagnosis had been made in reputable laboratories by recognized scientists. Kerr and Stimson in their investigation of the prevalence of rabies used a number of press clippings,

and in no instance did a press report lack official confirmation, which is quite contrary to the general opinion on this subject.

#### IN THE UNITED STATES

In looking over the proceedings of the American Veterinary Medical Association for more than 20 years, it was observed that rabies is reported as existing in a number of States each year, although there has been no special endeavor on the part of the resident State secretaries to ascertain the extent of this particular disease in their sections. In 1897 the disease was reported in 4 States, in 1898 in 5 States, while in 1899 the statement of Huidekoper was cited by Parker to the effect that the disease was not west of the Rockies and was rare in the United States except in Pennsylvania and Massachusetts. However, in the 1900 report we find that the disease had appeared in Montana, Wyoming, and Colorado, in addition to certain Eastern and Central Western States. It is evident from the succeeding reports that the disease was becoming more widespread, and at the meeting of the American Veterinary Medical Association in Philadelphia in 1908, of the 20 resident State secretaries who reported, 13 incidentally mentioned the existence of rabies in their States, and in Alabama, Connecticut, the District of Columbia, Minnesota, Mississippi, and Ohio the disease seemed to be on the increase. As there was no apparent reason for mentioning the presence or absence of this disease, the failure of the reports from the remaining 7 States to refer to rabies should not be considered as indicative of its absence. In fact, the writer corresponded with officials in these 7 States, and replies were received from 5 of them to the effect that rabies had prevailed in their localities during 1908, thus showing that the disease existed in 18 of the 20 States mentioned in the 1908 report. We have since gone even further in our correspondence and have endeavored to find out if there is any State or Territory in the United States where rabies is unknown. From the information at the writer's disposal it would appear that the disease occurs in practically every State of the Union.

Many of the far Western States were free from rabies until 1909, when Southern California became infected. The disease then spread northward over California, into Oregon, Washington, Idaho, Nevada, and several years ago reached Utah, principally as a result of rabid coyotes, wolves, and dogs.

It would be entirely impracticable without registration laws to ascertain the extent of the disease among animals in the various infected sections, but the disease appears at times in certain centers with all the vigor of an enzootic, and such outbreaks have occurred in Jacksonville, Fla.; El Paso, Tex.; Norfolk, Va.; Kansas City, Mo.; Boston, Mass.; Chicago, Ill.; Baltimore, Md.; Washington, D. C.; Cleveland, Ohio; Pasadena and Los Angeles, Calif.; and certain sections of New York, Pennsylvania, Minnesota, Ohio, Missouri, and Michigan. Not only is there a gradual increase in the number of outbreaks of rabies, but many new centers which appear to be more or less permanent are being established from year to year. The fiscal year 1909 was the first year when over 100 cases of rabies were diagnosed in the Pathological Division of the Bureau of Animal Industry, and of the positive cases, 79 came from the District of

Columbia and 33 were divided among Virginia, Maryland, West Virginia, and South Carolina. In 1917 this laboratory diagnosed 68 cases of rabies; in 1918, 45 cases; in 1919, 75 cases; in 1920, 43 cases; in 1921, 29 cases; in 1922, 56 cases; and in 1923, 91 cases.

The following table, prepared by Kerr and Stimson, of the United States Public Health Service, gives a partial list of the number of laboratory diagnoses of rabies found in 1908 at the various institutions interested in the investigation of this disease. They call attention to the fact that these figures represent in many instances only a small proportion of the actual number of cases of rabies occurring in the various States. For example, while only 47 cases of rabies were actually demonstrated in Wisconsin, the State veterinarian estimated that 584 animals died of this disease during 1908.

*Positive findings of rabies in animals in the United States during 1908*

Diagnosis made by—	Number
Delaware State Board of Health laboratory .....	7
Connecticut State Board of Health laboratory .....	14
Florida State Board of Health laboratory .....	20
Indiana University, Bloomington, Ind. ....	12
Indiana State Board of Health laboratory .....	75
Baltimore (Md.) Pasteur Institute .....	74
Massachusetts cattle bureau .....	135
University of Michigan Pasteur Institute .....	101
New Hampshire State Board of Health .....	7
New Jersey State Board of Health .....	13
New York Pasteur Institute .....	60
North Carolina State laboratory of hygiene .....	21
Vermont State Board of Health .....	2
Wisconsin State hygienic laboratory .....	47
New York State Veterinary College .....	188
Minnesota State livestock board .....	15
Bureau of Animal Industry, Pathological Division, Washington, D. C. ....	121
Cleveland health department, east side .....	49
Pennsylvania State livestock sanitary board .....	103
Ohio State Board of Health laboratories .....	32
Virginia Pasteur Institute, Richmond .....	39
Biological laboratories, Brown University, Providence, R. I. ....	32
Total .....	1,167

Some years ago President Frank Wells, of the Michigan State Board of Health, made rabies largely the subject of his annual address and declared it was epidemic in Michigan. Vaughan, who reported as a special committee on rabies, intimated that it had gradually spread from New York, where it had prevailed for a number of years previous, into Ohio and thence to Michigan, having been diffused throughout the Lower Peninsula of Michigan. In fact, the disease became so widespread and so many people were bitten that the State appropriated funds for the establishment of a Pasteur institute in connection with the medical department of the University of Michigan. A Pasteur institute was likewise established in April, 1908, in Washington, D. C., in connection with the Hygienic Laboratory of the United States Public Health and Marine-Hospital Service, owing to the continued outbreak of rabies in that vicinity and the large number of people bitten by rabid animals. In addition, there are Pasteur institutes at Atlanta, Ga.; Austin, Tex.; Baltimore, Md.; Chicago, Ill.; Iowa City, Iowa; Jacksonville, Fla.; Minneapolis, Minn.; Montgomery, Ala.; Newark, Del.; New Orleans, La.; Pittsburgh, Pa.; Raleigh, N. C.; Richmond, Va.; Reno, Nev.;

Salt Lake City, Utah; St. Louis, Mo.; two in Indianapolis, Ind.; and two in New York City.

As an indication of both the distribution and the prevalence of rabies among animals may be considered the number of persons who have been treated at these institutes. The directors of the Pasteur institutes were requested to furnish this information, and the majority responded. From these reports it is evident that many thousand people have been subjected to the Pasteur treatment, and several thousand receive the treatment every year as a result of bites inflicted by rabid animals.

As a further indication of the number of persons bitten but who did not take the Pasteur treatment are the census reports showing the mortality statistics from rabies. In the census of 1900, when only about 40 per cent of the population resided in districts where registration was observed, 123 deaths from rabies distributed in 20 States were reported. That this number was entirely too low was shown by Salmon in 1900, who corresponded with a number of health officers within and without the registration districts and collected 230 authentic cases of hydrophobia in man during this same interval in 73 cities.

Even with the improved facilities for treating persons bitten by rabid animals, many deaths occur every year, as shown by vital statistics of the Census Bureau. During the 10 years from 1911 to 1920, inclusive, according to the census report of 1920, there were 633 deaths of persons from rabies, an average of 63 a year. These deaths occurred in the registration area of the United States, which in 1920 included only 58 per cent of the total population. The figures must be considered only as a general index of the extent of the disease, owing to the constantly changing registration area.

#### IN OTHER COUNTRIES

The disease in foreign countries has at times appeared in the form of severe enzootics extending over considerable territory. During the decade preceding the World War the affection decreased on the whole, and in some places disappeared entirely, owing to the rigid enforcement of muzzling and quarantine regulations. Recent reports, however, show that rabies is more widespread on the Continent of Europe than it was before the war. This condition is probably due to the relaxed enforcement of regulations during and following the war, large numbers of stray dogs being permitted to run at large. In France the monthly number of cases in animals, mostly dogs, reported officially in 1921 and 1922, ranged from 131 to 219. Before the war the disease was quite prevalent in the eastern and southern provinces of Germany and in Russia, Austria, Hungary, Italy, Rumania, Serbia, Bulgaria, and Spain, and less so in the Netherlands, Belgium, Switzerland, and the western portion of Germany. German army veterinarians during the war frequently encountered the disease in the Baltic Provinces, where foxes were the principal agents of transmission. In Turkey, despite the large number of dogs, the disease has not been extensively observed, which is explained by Remlinger by the fact that it generally appears in the form of dumb rabies.

Denmark, Sweden, and especially Norway, have been free from the contagion for years, owing to the wise provision that all dogs running at large shall be muzzled.

Great Britain, which had remained free from rabies for 16 years, became reinfected in 1918, supposedly as the result of an aviator's breaking the quarantine regulations by bringing a dog from France in his airplane. This one case led to 129 others in two counties. Other outbreaks occurred also from dogs smuggled in by returning soldiers. From 1918 to 1921 the British authorities reported 319 cases. Eradication was accomplished by muzzling. A single case appeared in May, 1922, since which time no further cases have been reported.

The islands of Australia, Tasmania, New Zealand, St. Helena, and the Azores have never become infected with rabies. The first three prevent its introduction by rigid inspection and quarantine.

The disease is reported as existing in Canada, Mexico, and the Philippine Islands. The Pasteur Institute in the City of Mexico treated more than 10,000 patients from all over the country in 26 years. The disease is also known to occur at infrequent intervals in certain sections of South America, Africa, and Asia. In recent years it has been definitely reported in Japan and Morocco.

#### PREVENTION AND ERADICATION

Sanitary regulations which seek to control the disease effectively by exterminating it among dogs are most likely to prove successful. There is no communicable disease which is more easily prevented or eradicated than rabies. Since the infection is practically always transmitted by a bite, and since the animal which does the biting is almost always a dog, all sanitary measures must be directed to the control of these animals for a sufficient time to cover the incubation period of the disease. It seems inexcusable, therefore, to allow this contagion to be propagated indefinitely, causing untold suffering to the affected animals and menacing the lives of persons, particularly children, who go upon the streets.

The only measures necessary to obtain the desired result are (1) a tax or license for all dogs, with a fee of \$2 for males and \$5 for females, and the destruction of homeless or vagrant dogs; (2) restraint of all dogs which appear in public places, either by the use of a leash or an efficient muzzle.

#### DOG LICENSE

There is no doubt that neglect has allowed the accumulation of ownerless dogs in this country to an extent that renders our large cities frequently liable to incursions of rabid animals. Even to mention muzzling, however, is sufficient to bring tirades of abuse upon the head of the sanitarian, and dog sentimentalists are immediately up in arms, using time, influence, and money to prevent such an ordinance. In spite of the obloquy with which it is received by a certain mistaken class of the community, the results of muzzling amply justify its recommendation, and its rigid enforcement without any additional requirement will exterminate rabies in a district in a shorter time than any other known method. Even Dulles, the great controversialist on rabies, admits that he considers muzzling to be the most important measure for limiting the ravages of this disorder, no matter on what theory it may be accounted for. Excellent examples of its efficiency are shown by the well-known results obtained in eradicating the disease from England, Sweden, Denmark, Berlin, and in other communities.



## NECESSITY FOR MUZZLING

The striking results obtained by England have caused many persons to propose and advocate a national dog-muzzling law for the United States, enforced by the Department of Agriculture. These suggestions, however, do not take into consideration the discrimination between the functions of the Federal and State Governments and the differences between the laws of the United States and those of England. The power conferred is not in all cases sufficient to effect the eradication of a disease, for the reason that the Federal Government can not enforce measures within a State without the legislative consent of the State unless the animals affected are subjects of or endanger interstate commerce. Its work, therefore, without the cooperation of the States affected, is limited to interstate traffic, and quarantine lines are thus made to follow State lines. The department is always willing to cooperate, so far as possible, with any State which requests assistance in eradicating an infectious disease. But such a State must necessarily have the proper laws by which the control of the disease is made possible. When a disease such as rabies is confined within a State it does not come under the jurisdiction of the Federal Government and can not be treated as the infectious diseases pleuropneumonia and foot-and-mouth disease, which spread from State to State and become a serious menace to interstate traffic. The Department of Agriculture could quarantine against States where the rabies exists, but it can readily be seen that, owing to the great freedom of movement which dogs enjoy, it would be impracticable to enforce such a quarantine further than to require all dogs to be muzzled which are being transported interstate by common carriers. Such a requirement would give an infinitesimal amount of protection, as these dogs would be beyond the Federal jurisdiction after reaching the State to which they were destined.

If all States should enact muzzling laws, or if the State boards of health, State sanitary boards, and municipal authorities in the infected States should be empowered to issue and enforce regulations compelling the muzzling of all dogs in the infected area and the impounding or humane destruction of all dogs found running at large, the disease would soon be stamped out.

In order to secure State and municipal legislation for the control of rabies it will require concerted action on the part of all interested parties, whether professional men or laymen, to prove to the public the need, value, and benefits of such a procedure. With such legislation properly enforced no dog would be seen running at large without a muzzle. Those contracting the disease would be unable to transfer the virus to other animals. Monetary loss, untold suffering, and death among both human beings and animals caused by the disease would rapidly decrease, and in a relatively short period rabies would be eradicated from our country. After reaching this desired goal the reappearance of the disease could be readily prevented by a six months' quarantine of all dogs imported in the United States from countries where rabies is prevalent.